

REMARKS

By the present amendment and response, claims 16, 22, 34, and 35 have been amended to overcome the Examiner's objections. Claims 16-36 are pending in the present application and claims 28-33 have been allowed. Reconsideration and allowance of outstanding claims 16-27 and 34-36 in view of the following remarks are requested.

The Examiner has rejected claims 16, 19, 20, 23, 26, and 34 under 35 USC §102(e) as being anticipated by U.S. published patent application publication number 2002/0089062 to Saran et al. ("Saran"). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claims 16 and 34, is patentably distinguishable over Saran. However, Applicant reserves the right to provide declarations and/or documents under 37 CFR §1.131 to "swear behind" the effective filing date of Saran.

Subject to Applicant's reserved right to establish priority of the present invention under 37 CFR §1.131, Applicant submits that the present invention, as defined by amended independent claim 16, teaches, among other things, "low-k material filling all of the gaps between the metal lines and having at least one vertical portion, said at least one vertical portion of said low-k material extending above said metal lines," and "a protective layer formed directly over and in direct contact with the metal lines and the low-k material, wherein the protective layer covers said at least one vertical portion of the low-k material." As disclosed in the present application, the protective layer is in contact with the metal lines, the low-k material situated between the metal lines, and the at least

one vertical portion of the low-k material that extends above the metal lines. As a result, the protective layer provides an etch stop that protects the low-k material from chemicals utilized to etch vias in the dielectric layer situated above the metal lines and, thereby, prevents the undesirable formation of poisoned vias, which can occur when the low-k material is exposed to the via etch chemicals. Thus, by utilizing low-k material situated in the gaps between metal lines and a protective layer in contact with the metal lines and the low-k material, including the at least one portion of the low-k material that extends above the metal lines, the present invention advantageously achieves an interconnect having reduced interconnect capacitance without suffering the undesirable effects of poisoned vias.

In contrast, Saran does not teach, disclose, or suggest “low-k material filling all of the gaps between the metal lines and having at least one vertical portion, said at least one vertical portion of said low-k material extending above said metal lines,” and “a protective layer formed directly over and in direct contact with the metal lines and the low-k material, wherein the protective layer covers said at least one vertical portion of the low-k material.” Saran is generally directed to a bond pad reinforcing system that is compatible with the damascene metallization process. See, for example, Saran, page 1, paragraph [0009]. Saran specifically discloses reinforcing structure 10 and dielectric layers 13a and 13b, where dielectric layer 13b is situated above reinforcing structure 10 and dielectric layer 13a is situated above dielectric layer 13b. See, for example, page 1, paragraph [0031] and Figure 2 of Saran. In Saran, reinforcing structure 10 comprises

patterns of alternating low-k dielectric 14 and metal 15, which must have the same layer thickness and form a uniformly flat interface to dielectric layers 13b and 13a. See, for example, page 3, paragraph [0031] and Figure 2 of Saran.

Thus, since Saran requires patterns of low-k dielectric 14 and metal 15 to have the same layer thickness and form a uniformly flat interface, Saran teaches away from having at least one portion of low-k dielectric 14 extend above metal 15. Moreover, Saran states that an advantage of using the damascene technique is the fact that no thin film of weak dielectric, i.e. low-k dielectric 14, is left atop reinforcing structure 10. See, for example, Saran, page 3, paragraph [0033].

For all the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 16, is not suggested, disclosed, or taught by Saran. Thus, amended independent claim 16 is patentably distinguishable over Saran and, as such, claims 19, 20, 23, and 26 depending from amended independent claim 16 are, *a fortiori*, also patentably distinguishable over Saran for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The present invention, as defined by amended independent claim 34, teaches, among other things, “material filling all of the gaps between the metal lines and having at least one vertical portion, said at least one vertical portion of said material extending above said metal lines,” and “a protective layer formed directly over and in direct contact with the metal lines and the material, wherein the protective layer covers said at least one vertical portion of the material.” For the same reasons as discussed above, the invention,

as defined by amended independent claim 34, is not suggested, disclosed, or taught by Saran. Thus, the present invention, as defined by amended independent claim 34, is also patentably distinguishable over Saran.

The Examiner has further rejected claims 35 and 36 under 35 USC §102(e) as being anticipated by U.S. patent number 6,222,269 to Tatsuya Usami ("Usami"). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claim 35, is patentably distinguishable over Usami. However, Applicant reserves the right to provide declarations and/or documents under 37 CFR §1.131 to "swear behind" the effective filing date of Usami.

Subject to Applicant's reserved right to establish priority of the present invention under 37 CFR §1.131, Applicant submits that the present invention, as defined by amended independent claim 35, teaches, among other things, "low-k material filling all of the gaps between the metal lines and having at least one vertical portion, said at least one vertical portion of said low-k material extending above said metal lines." The present invention as defined by amended independent claim 35 provides similar advantages as the present invention as defined by amended independent claim 16 discussed above.

In contrast, Usami does not teach, disclose, or suggest "low-k material filling all of the gaps between the metal lines and having at least one vertical portion, said at least one vertical portion of said low-k material extending above said metal lines." Usami specifically discloses an interconnect comprising a plurality of lower interconnect lines 3 formed on first stopper layer 2, which is formed on thick insulating layer 1 on the surface

of a semiconductor substrate. See, for example, column 5, lines 55-65 and Figure 1 of Usami. In Usami, first interlevel insulator 4 is formed in a widely spaced region between adjacent lower interconnect lines 3, while low dielectric constant layer 5 is formed in a narrowly spaced region between adjacent lower interconnect lines 3. See, for example, column 5, lines 66-67, column 6, lines 1-2 and Figure 1 of Usami. Thus, in Usami, low dielectric constant layer 5 is formed only in narrowly spaced regions between adjacent lower interconnect lines 3, not in widely spaced regions. Thus, in Usami, low dielectric constant layer 5 is situated in gaps or spaces between some of adjacent lower interconnect lines 3, while first interlevel insulator 4 is situated in gaps or spaces between other adjacent lower interconnect lines 3.

Furthermore, in Usami, an interlevel insulator having a small coefficient of thermal expansion and high strength is used in the widely spaced region between interconnect lines to overcome the problem of crack generation which would take place if a low-dielectric constant insulating layer were used in all the regions (both widely and narrowly spaced regions) as an interlevel insulator. See, for example, Usami, column 8, lines 21-27. Thus, Usami teaches against using a low dielectric constant layer in all of the regions between interconnect lines.

Additionally, in Usami, during formation of the interconnect structure, low dielectric constant layer 5 is polished by a CMP method to remove unnecessary portions from the layer and planarized. See, for example, column 7, lines 37-39 and Figure 3D of Usami. Thus, by planarizing low dielectric constant layer 5, Usami teaches away from

having at least one portion of low dielectric constant layer 5 extend above lower interconnect lines 3.

For all the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 35, is not suggested, disclosed, or taught by Usami. Thus, amended independent claim 35 is patentably distinguishable over Usami and, as such, claim 36 depending from amended independent claim 35 is, *a fortiori*, also patentably distinguishable over Usami for at least the reasons presented above and also for the additional limitation contained in the dependent claim.

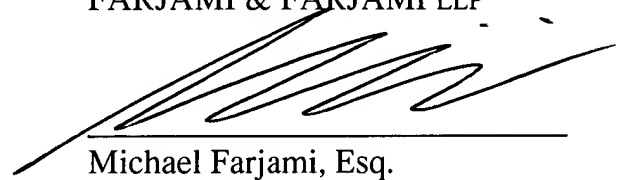
The Examiner has further rejected claims 17, 18, 21, 22, 24, 25, 27, 35, and 36 under 35 USC §103(a) as being unpatentable over Saran. As discussed above, amended independent claim 16 is patentably distinguishable over Saran and, as such, claims 17, 18, 21, 22, 24, 25, and 27 depending from amended independent claim 16 are, *a fortiori*, also patentably distinguishable over Saran for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The present invention, as defined by amended independent claim 35, teaches, among other things, “low-k material filling all of the gaps between the metal lines and having at least one vertical portion, said at least one vertical portion of said low-k material extending above said metal lines,” and “a protective layer formed directly over and in direct contact with the metal lines and the low-k material, wherein the protective layer covers said at least one vertical portion of the low-k material.” For the same reasons as discussed above, the invention, as defined by amended independent claim 35, is not

suggested, disclosed, or taught by Saran. Thus, the present invention, as defined by amended independent claim 35, is also patentably distinguishable over Saran and, as such, claim 36 depending from amended independent claim 35 is, *a fortiori*, also patentably distinguishable over Saran for at least the reasons presented above and also for the additional limitation contained in the dependent claim.

Based on the foregoing reasons, the present invention, as defined by amended independent claims 16, 34, and 35 and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 16-27 and 34-36 are also patentably distinguishable over the art cited by the Examiner. For all the foregoing reasons, an early allowance of outstanding claims 16-27 and 34-36 and an early Notice of Allowance for all claims 16-36 pending in the present application is respectfully requested.

Respectfully Submitted,
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